

PROPOSED

State of California
AIR RESOURCES BOARD

**Long-term Characterization of Fine PM Chemical Composition in the
San Joaquin Valley**

RESEARCH PROPOSAL

Resolution 17-37

October 26, 2017

Agenda Item No.: 17-10-3

WHEREAS, the California Air Resources Board (CARB or Board) has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2813-287, titled "Long-term Characterization of Fine PM Chemical Composition in the San Joaquin Valley," has been submitted by the University of California at Davis for a total amount not to exceed \$320,000;

WHEREAS, the Research Division staff have reviewed Proposal Number 2813-287 and finds that in accordance with Health and Safety Code section 39701, the results of this study will provide insights into the sources and key atmospheric processes that drive PM_{2.5} formation in the San Joaquin Valley during different seasons and supply a scientific basis for the development of optimal air quality attainment strategies; and

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends funding the Research Proposal.

NOW, THEREFORE BE IT RESOLVED, that CARB, pursuant to the authority granted by Health and Safety Code sections 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and staff and approves the Research Proposal.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the Research Proposal as further described in Attachment A, in an amount not to exceed \$320,000.

Resolution 17-37

October 26, 2017

Identification of Attachments to Board Resolution 17-37

Attachment A: “Long-term Characterization of Fine PM Chemical Composition in the San Joaquin Valley” Summary and Budget Summary

ATTACHMENT A

Long-term Characterization of Fine PM Chemical Composition in the San Joaquin Valley

Background

Particulate pollution in the San Joaquin Valley (SJV) remains the worst in the United States despite decades of regulatory efforts, frequently exceeding the 24-hour PM_{2.5} National Ambient Air Quality Standard (NAAQS) of 35 $\mu\text{g}/\text{m}^3$ during the winter and often exceeding the annual PM_{2.5} NAAQS. This intractability of aerosol concentrations is caused by the complex interactions between primary and secondary air pollution that lead to various chemical reactions and atmospheric processes during different seasons. Despite rigorous research studies by various research groups and regulatory agencies, there are various PM production mechanisms that are not yet fully understood. Although the SJV is moving towards cleaner air quality as a result of California's air pollution control strategies, additional measures must be taken to continue improving the regional air quality and to develop State Implementation Plans to meet future NAAQS. Additional information is needed to better characterize the chemistry and the transport of air pollutants to develop effective control programs in the SJV.

Objective

The proposed study will collect long-term, hourly-resolved measurements of non-refractory PM_{2.5} (NR-PM_{2.5}) composition using a Time-Of-Flight Aerosol Chemical Speciation Monitor (TOF-ACSM) at a monitoring site in the SJV for two consecutive years. The data collected during this study will be used to better understand the various atmospheric processes that lead to PM_{2.5} production.

Methods

The proposed work will measure mass concentrations of NR-PM_{2.5} species (NO_3^- , NH_4^+ , SO_4^{2-} , Cl⁻ and organic aerosol) with less than 1-hour time resolution for two consecutive years. The TOF-ACSM is a recently-developed commercial instrument that provides *in-situ* measurements of aerosol mass and chemical composition of non-refractory PM. The TOF-ACSM will be evaluated for its performance and data quality prior to deployment. Detailed quality control and quality assessment procedures will be constructed. The long-term air quality data will be used to assess the patterns in diurnal profiles of NR-PM_{2.5} species to determine how atmospheric parameters and air pollution emissions affect PM_{2.5} chemical composition. This analysis will be extended to assess seasonal variations in NR-PM_{2.5} to understand its seasonality and source contributions. Additional data analysis will evaluate the air quality on weekends versus weekdays and burning-allowed versus burning-not-allowed periods. These analyses will also explore the relationships between PM_{2.5} composition and meteorological parameters, especially relative humidity and temperature.

Expected Results

This proposed project will shed additional light into the various PM_{2.5} formation processes at a significantly higher time resolution throughout the year to develop a comprehensive and a more complete understanding of PM_{2.5} production in the SJV.

Significance to the Board

Results are expected to provide insights into the sources and key atmospheric processes that drive PM_{2.5} formation in the SJV during different seasons and supply a scientific basis for the development of optimal PM_{2.5} ammonium nitrate and organic aerosol mitigation policies.

Contractor:

University of California, Davis (UCD)

Contract Period:

36 months

Principal Investigators (PIs):

Christopher Cappa, Ph.D., UCD

Co-PI: Qi Zhang, Ph.D., UCD

Co-PI: Sally Pusede, Ph.D., University of Virginia

Contract Amount:

\$320,000

Basis for Indirect Cost Rate:

The State and the UC system have agreed to a 25 percent indirect cost rate.

Past Experience with the Principal Investigators:

Dr. Christopher Cappa and Dr. Qi Zhang are currently finishing the work, including the final report, on a related project with CARB on PM formation in the San Joaquin Valley, titled "Characterization of PM_{2.5} Episodes in the San Joaquin Valley Based on Data Collected during the NASA DISCOVER-AQ Study in the Winter of 2013," contract no. 14-307. In this work, the PIs determined that concentrations of secondary aerosols in the SJV peaked in the morning as the nocturnal residual layer aloft was mixed down; they constructed a model that incorporates nocturnal residual layer chemistry and daytime mixing and found that significant portion of nitrate was formed during the night through N₂O₅ hydrolysis in the SJV. The ground-based aerosol measurements for this work were conducted by Dr. Qi Zhang using an instrument similar to the TOF-ACSM. Dr. Zhang's expertise in the operation and data interpretation for similar aerosol mass spectrometer based instruments is critical to the success of this project.

In a related study with Dr. Cappa and Dr. Zhang, Dr. Sally Pusede published her work, "On the Effectiveness of Nitrogen Oxide Reductions as a Control over Ammonium Nitrate Aerosol," which furthered the conceptual model for nitrate formation in the

residual layer in the SJV. As a team, they bring expertise from aerosol mass spectrometer instrument operation and data interpretation to conceptual model development and mitigation effect predictions to this project.

Prior Research Division Funding to the University of California at Davis:

| Year | 2016 | 2015 | 2014 |
|---------|------------|-------------|-------------|
| Funding | \$ 650,000 | \$1,468,460 | \$2,249,136 |

B U D G E T S U M M A R Y

Contractor: University of California at Davis

“Long-term Characterization of Fine PM Chemical Composition in the
San Joaquin Valley”

DIRECT COSTS

| | | | |
|--------------------|--|----|---------------|
| 1. | Personnel (Salary and Fringe Benefits) | \$ | 45,207 |
| 2. | Travel | \$ | 9,948 |
| 3. | Materials & Supplies | \$ | 6,950 |
| 4. | Equipment | \$ | 219,098 |
| 5. | Electronic Data Processing | \$ | 0 |
| 6. | Consultant(s) | \$ | 0 |
| 7. | Sub-recipient(s) | \$ | 0 |
| 8. | Other Direct Costs | \$ | <u>23,270</u> |
| Total Direct Costs | | | \$ 304,473 |

INDIRECT COSTS

| | | | |
|----------------------|-----------------------------------|----|------------------|
| 1. | Indirect (F&A) Costs ¹ | \$ | 15,526 |
| | | \$ | <u>0</u> |
| Total Indirect Costs | | | \$ <u>15,526</u> |

TOTAL PROJECT COSTS **\$ 320,000**

Note:

¹ Facilities & Administrative costs.